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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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Knowledge and Understanding.

Science and Life: Aberdeen Addresses. By Prof. Frederick Soddy. Pp. xii + 229. (London: John Murray, 1920.) Price 10*s.* 6*d.* net.

> Hear, Land of Cakes and brither Scots,
> Frae Maidenkirk to Johnny Groat's;
> If there's a hole in a' your coats,
> I rede ye tent it;
> A chiel's amang ye takin' notes,
> And, faith, he'll prent it.

PROF. SODDY, who has recently removed from the chair of chemistry in the University of Aberdeen to the newly created Lee's professorship of inorganic and physical chemistry in the University of Oxford, is well known throughout the scientific world by reason of his work in connection with the subject of radio-activity, to which he has made very important contributions. But it was not suspected, at least generally, that from his northern post of observation he was finding so many holes in the coats of the inhabitants of that part especially, and of the institutions of the country generally, and that he would "prent it." Yet here is a volume which bears as sub-title "Aberdeen Addresses," the delivery of which must have caused many of his "unco' guid" neighbours to sit up and perhaps *furieusement à penser.* But, as the old clerk in "Silas Marner" said: "Where's the use o' talking? You can't think what goes on in a cute man's inside."

We must all agree with the author in the view that "the times seem to call for outspokenness, if one has anything to say, rather than persuasive propagandism and time-serving compromise. It may be recalled that scientific men have, for nearly a century, pointed out the dangers to the nation of the traditional school and university training, disastrous especially in that it embraces even those who are to be its rulers and statesmen." So Prof. Soddy has spoken out with a voice which is bound to be heard even by those who, having no ears to hear, or understanding to learn, cannot help catching the echoes of this new trumpet-call.

The essays may be broadly divided into two groups, of which one contains an exposition of the marvellous disclosures concerning the physical constitution of matter which have absorbed the concentrated attention of so many physicists during the last twenty years, while the second group, addressed to various audiences, shows the bearing of modern scientific discovery on the philosophies hitherto prevalent.

Let us glance first at the former set of essays. For nearly a century the atomic theory of Newton and Dalton had been accepted by chemists as the almost undisputed basis of their theoretical conceptions, and for all ordinary chemical phenomena the atom is still the fundamental unit of mass. Views as to the nature of the atom and its constitution now assume a different form. It is as though an observer, looking along a street, having formerly supposed each house to consist of a solid mass of bricks, now finds out that each contains many chambers and inhabitants capable of moving about. This knowledge has been obtained in two ways. By bombardment the constituent materials and inhabitants have been distributed in various directions, and in a strange, unaccountable way the inhabitants of certain houses escape from them carrying away portions of the fabric, which is thus gradually led to tumble down. The metaphor can be carried no farther, but is sufficient to remind the reader of the conceptions gradually introduced as the result of experimental work carried on first by Crookes, and later especially by Sir Joseph Thomson, and, on the other hand, by the discoveries of

Becquerel and the Curies in connection with radio-activity.

Prof. Soddy has been associated with research on radio-activity since 1901, when, in Sir Ernest Rutherford's laboratory in Montreal, he joined in framing the idea which attributes radio-active change to the spontaneous disintegration of the atom. Later, in conjunction with Ramsay, he proved that the α-particles escaping from radium are electrified atoms of helium. In 1913 he also traced, simultaneously with other observers, the nature of the successive changes in radio-active matter which ultimately lead to the production of non-radio-active elements, of which the best-known case is lead. The whole story is told in a condensed form in several of the essays in this volume, and it could not be told better. Those who are interested in such subjects should obtain the book and read it.

Turning, now, to the remainder of the contents of this volume, so many questions are touched on of which many would be regarded as debatable that it seems probable that readers will be divided into two camps, those who would cordially approve and support the views set forth, and those, chiefly the orthodox, who would deeply resent the attitude and conclusions of the writer. The first article, entitled "Science and Life," deals with the influence which scientific discovery has exercised on the conditions of modern life, seen from various points of view; and contains little that is seriously controversial. There are, of course, passages which seem a little over-enthusiastic—*e.g.* the statement that, "if not yet, some time in the future, the synthesis of food from the material constituents and any form of available energy will probably become possible"—but the review given of the sources of energy in Nature is useful as popular instruction. The author's remarks on the relations of brains, labour, and capital seem rather to belong to the views likely to find expression at the meetings of a young men's debating society, though it is certainly true that "the exploiters of the wealth of the world are not its creators," and is likely to remain so until human nature undergoes a profound change. A similar remark might be made on the question which occurs in the second article: "Physical force, the slave of science, is it to be the master or the servant of man?"

Of course, Prof. Soddy has a good deal to say on the subject of education. He is an experienced and distinguished teacher, but in one direction he seems to overlook the necessity for clearly differentiating the kind of general education which must necessarily be provided wholesale for the great majority, and that which should be adapted to the exceptional youth, the genius, that *rara avis* for whom is wanted more in the shape of opportunity than in direct instruction along lines which may or may not be useful to him. The great difficulty in regard to this kind of student is to recognise his qualities early enough. In connection with the continued appropriation of more than their due share of scholarships, emoluments, and facilities of all kinds by the authorities and powers which claim to represent humanist interests at the schools and universities, everyone concerned with such matters remembers Prof. Soddy's criticism of the action of the executive committee of the Carnegie Trust for the Universities of Scotland in January, 1918, and the inadequate reply thereto. The whole of the relevant papers are added to this volume in a series of appendices A, B, and C.

Many people will find the lecture given to the Aberdeen University Christian Union on "Matter, Energy, Consciousness, and Spirit" among the most startling of the utterances contained in this book. There are still many serious religious persons who find the almost universal abandonment of the Mosaic account of Creation and of so many of the Hebrew legends disturbing to the whole of their Christian faith and subversive of all religion. But the religious reader may get some comfort from this chapter if he will read it thoughtfully and with prejudice discarded as much as possible. Truth in the realm of science is of a quality and nature quite its own, and the man of science who frames a hypothesis does so in the knowledge that, while it responds to every test applied to it up to that moment, it may be modified by further discovery or absorbed into and covered by a theory of a more comprehensive character. The continuous advance of knowledge proves, however, that the foundations have been well and truly laid. "The scientific man seeks truth as a continually developing revelation, and he changes his outlook on the world according as it unfolds itself before his eyes. The priest teaches that in some remote period of the world God Himself revealed Truth once and for all time, and his profession is to guard it against all comers. I do not believe that the soul, any more than the mind, can stagnate. It must grow or decay. Christianity cannot be crystallised into a creed binding for all time, and least of all into a creed dating back to the century that preceded the relapse of Europe into intellectual barbarism. The world changes and has changed in the last hundred years out of all recognition . . . on account of the new revelations of science, though these have come about by a process the reverse of supernatural. . . . They constitute an essential part of the whole truth, be our religious convictions what they may."

And there we must leave this interesting volume to the judgment of the many readers who will certainly be attracted by its contents.

W. A. T.

A Natural History of the Feelings.

The British Journal of Psychology: Monograph Supplements. No. vi. Pleasure—Unpleasure: An Experimental Investigation on the Feeling-Elements. By Dr. A. Wohlgemuth. Pp. vii+252. (Cambridge: At the University Press, 1919.) Price 14*s*. net.

WHAT the psychologists of the Würzburg school have so largely done for the thought processes, Dr. Wohlgemuth has here attempted for the feeling-elements of the mind. The investigation consists essentially of a lengthy series of introspections on the affective states produced by various sensory stimuli—given singly or in combination—carried out by four trained observers under strictly experimental conditions, the data thus obtained being submitted to a detailed consideration and analysis, and eventually summarised and expressed in seventy-seven rules. These rules, the author maintains, may be regarded as a first step towards the building up of a natural history of the feeling-elements—a task which should precede any systematic attempt at theorisation or at the application of the psychology of feeling to practical life.

A novelty in the presentation as regards work of this kind consists of the fact that the data from which the conclusions are drawn (*i.e.* the protocols of the observers) are recorded in full, occupying the largest portion of the book (137 closely printed pages), references in the margin indicating passages in the protocols from which the subsequently stated conclusions have been drawn. From the purely scientific point of view, this procedure has everything to recommend it. There exist no well-recognised and trustworthy methods of summarising introspective data, such as there are, for instance, in the case of purely quantitative results, and the presentation of the complete material enables the reader and critic to control at each step the author's conclusions, or to draw new and independent conclusions of his own, in a way that would not otherwise be possible. The opportunity of studying the observers' gradually increasing power of analysing and describing the fleeting affective contents of the mind should, moreover, be welcome to all who are interested in the possibilities of the modern method of exact introspection in psychology. On the other hand, the inclusion of the full data has increased by not a little the size (and doubtless also the cost) of the present work.

It is impossible to summarise adequately the wealth of conclusions arrived at from the study of the protocols. A very few only of the more salient points can be mentioned here. The observers find that "the feeling-elements are not attributes or functions of sensations or other cognitive processes, but a separate class of conscious processes. Although generally closely dependent upon the cognitive and conative processes to which they belong, they often show a certain independence and detachment." The feeling-elements possess two qualities only—pleasure and unpleasure, this result supporting the more common view as against the multi-dimensional theories advanced by Wundt and certain others. Unpleasure must be clearly distinguished from pain, which is not a feeling, but a sensation—"a sensation of a definite modality whose feeling tone is mostly unpleasant, but which may be neutral or sometimes even pleasant."

As regards the much-disputed question concerning the possibility of the co-existence in consciousness of distinct feeling-elements, some fairly strong evidence is brought in favour of such co-existence, the co-existing feelings being either of the same quality (*i.e.* both pleasant or unpleasant) or of different qualities (*i.e.* one pleasant, the other unpleasant). There are, however, important individual differences in the ease and frequency with which such co-existence can be observed.

A further disputed question—that of the localisability of the feelings—is also answered in the affirmative, the localisation of feelings being closely dependent on the observer's power of objectifying the feelings in question. In this connection it is interesting to observe that "the behaviour of feeling-elements is inverse to that of sensations in this way, that whilst sensations of the auditory and visual senses are more readily objectified than those of other senses, the feeling-elements when belonging to the former are less readily objectified and localised than when they belong to the latter."

An important difference between feeling and sensation was found in the fact that "there is nothing on the affective side of consciousness to correspond with the memory image on the cognitive side. The memory of a past feeling-element is merely knowledge—*i.e.* solely cognition. The affective experience attaching to an ekphored [*i.e.* recalled] cognitive experience is a new feeling-element, a new pleasure or a new unpleasure."